# Drivers of Healthcare Resource Utilization

A Thesis

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Master of Science

By

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ABSTRACT

*MANUSCRIPT 1:*

BACKGROUND: Hot spotting is a population management method for identifying high utilizers and enabling them to receive intensive case management services. However, since this method is retrospective, the benefit from hot spotting is reaped only after patients have become high utilizers. Studies looking at prospective hot spotting offer a promising alternative, as patients at high risk of becoming high utilizers can be identified, and interventions can be implemented.

OBJECTIVES: The aim of this review is to summarize literature that examines how investigators identify high utilizers, describes characteristics of high utilizers, evaluates the effects of interventions aimed at reducing unnecessary utilization, and compare and contrast methods of hot spotting.

METHODS: PUBMED and Scopus were with keywords “patient”, retention”, “patient disenrollment”, “healthcare system”, “frequent users”, “patient centered medical home”, and “primary care”. The following MeSH terms were also used: “patient centered care”, “primary care”. Abstracts were screened, and then selected by the author.  Systematic reviews, retrospective cohort, randomized controlled trials that described characteristics of high utilizers or patients of a similar nature were ultimately chosen. Studies with were also

selected if interventions were tested with outcomes of cost and/or frequencies of visits were used.

RESULTS: Definitions of high utilization varied. Most were in the setting of the emergency department. High utilizers had multiple chronic diseases, were mostly women, had Medicare or Medicaid, impoverished, have mental health issues, and substance abuse problems. Models for identifying high utilizers used prior visit history and various clinical data points to generate an algorithm for patient identifications. Targeted case management interventions seem to decrease the frequency of emergency department visits.

CONCLUSION: The literature shows evidence of effective models for identifying high utilizers. However, current models do not adequately capture a transformation of a patient to a high utilizer.

MANUSCRIPT 2:

BACKGROUND: Reducing healthcare utilization is a critical national focus. Though patients with a high burden of chronic disease measured by the Charlson Comorbidity Index accounts for a disproportionate amount of healthcare costs, as a result of emergency department (ED) and inpatient visits, reasons for high utilization are complex and incompletely understood.

OBJECTIVES: Within a managed care Medicaid population, identify characteristics among patients with a Comorbidity Index score of ≥ 4 who visit the ED. A secondary objective is to identify characteristics of patients who are hospitalized that are associated with ED visits.

METHODS: This study assessed 43 MetroPlus Medicaid patients in the South Bronx with comorbidity scores of ≥ 4, older than 18 years old, and able to speak English or Spanish. Patients were interviewed to assess demographic, psychological, clinical, social, and economic domains. The primary outcome was number of emergency room visits within 1 year prior to enrollment and up to 6 months after. The secondary outcome was non-elective inpatient hospitalizations during the same time frame.

RESULTS: 43 patients completed enrollment. 45% of patients had ED visits; those who had ED visits usually had more than one. Patients with and without ED visits did not differ according to: age (61 years old), gender (88% were women), ethnicity (88% Latino, employment status (86% unemployed),

acculturation (both groups were poorly acculturated). The major difference between high comorbid patients who did and did not have ED visits was social support. The major finding was that 71% of patients with low social support had an ED visit, while 27% of patients with high social support had an ED visit.

CONCLUSION:

While sample size limits restricts more conclusive statements to be made, the finding of patients with low social support having more ED visits deserves further investigation.

# BIOGRAPHICAL SKETCH

Nicholas Daniel Tyau was born and raised in Honolulu, Hawaii. He received his Bachelor of Arts in Biochemistry from Occidental College in Los Angeles, California. He earned his medical degree from Temple University's School of Medicine in Philadelphia, Pennsylvannia. He then completed his residency training in Internal Medicine at George Washington University in Washington, D.C. His current interests include innovations in health care delivery, methods of reducing unnecessary health care resource utilization, and health care disparities.

To Susan, Michael, Evelyn, and Daniel Tyau; To Shannon and Ethan Porter; To Akiko and Chong Leu; and to the rest of my family: ‘A‘ohe pau ka ‘ike i ka hālau ho‘okahi. (All knowledge is not learned in just one school)

To Jaime, Jeanette, and Nadya Suarez: Gracias para todo. Creo que “Union hace la fuerza” y son mi familia de Nueva York.

To my beloved wife, Monica Suarez, MD; thank you for encouraging and challenging my thoughts on healthcare. You help me grow as a physician and as a person every day.

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FIGURE 2.1. Charlson Comorbidity Index Scoring

Charlson comorbidity index adapted to predict total yearly costs of care

| Conditions | Weight |
|---|---|
| Congestive heart failure | 1 |
| Myocardial infarction | 1 |
| Peripheral vascular disease | 1 |
| Cerebrovascular disease | 1 |
| Dementia | 1 |
| Chronic pulmonary disease | 1 |
| Connective tissue disease | 1 |
| Ulcer disease | 1 |
| Mild liver disease | 1 |
| Diabetes | 1 |
| **Depression** | **1** |
| **Use of warfarin** | **1** |
| **Hypertension** | **1** |
| Hemiplegia | 2 |
| Moderate or severe renal disease | 2 |
| Diabetes with end organ damage | 2 |
| Any tumor | 2 |
| Leukemia | 2 |
| Lymphoma | 2 |
| **Skin ulcers/cellulitis** | **2** |
| Moderate or severe liver disease | 3 |
| Metastatic cancer | 6 |
| AIDS | 6 |

Bold items are newly added to the existing comorbidity index.

From Charlson et al. 2008

The Charlson Comorbidity Index was calculated by adding the total score accumulated by a patient. Any history of disease was sufficient for a score; diseases were not counted twice (e.g. multiple episodes of cellulitis were only counted once), only one diabetic end organ disease was counted, chronic pulmonary diseases were only counted once (asthma, chronic bronchitis, COPD were only counted once even if multiple diseases were listed), connective tissue disease excluded osteoarthritis, but included: psoriasis, rheumatoid arthritis, Sjogren's, sarcoidosis, any manifestation of Lupus, the scleroderma spectrum, mixed connective tissue disease, polymyositis, dermatomyositis, mild liver disease, included the diagnoses of Hepatitis B, Hepatitis C, non-alcoholic steatohepatitis, autoimmune hepatitis and cirrhosis (without mention of portal hypertension, varices, hepatocellular carcinoma, hepatic encephalopathy), moderate or severe renal disease was determined by a eGFR <60 as described by the Chronic Kidney Disease Guidelines published by the National Kidney Foundation, all malignant neoplasms were counted except from basal cell carcinoma of the skin, moderate/severe liver disease was considered cirrhosis with the presence of portal hypertension, ascites, hepatocellular carcinoma, hepatic encephalopathy.

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# CHAPTER 1:

## *A Review of Retrospective Hotspotting*

There are no conflicts of interest to report.

# A Narrative Review on Identifying High Utilizers: Patching Together A Shattered Vase Versus Preventing Its Crash

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## INTRODUCTION

Chronically ill patients who suffer with multiple medical comorbidities, mental illness, and complex social circumstances, and who have had numerous emergency department (ED) visits and hospitalizations are known as high utilizers. The significant and disproportionate consumption of health care resources by high utilizers is well studied.[1-3] The Camden Coalition employed a method called hot spotting, which, as described by Atul Gawande in 2011, involved using visit charges and clinical data to identify high utilizers, and then assigning case management teams to help high utilizers navigate the healthcare system and access social services.[4] This method of applying case management interventions to high utilizer populations has been demonstrated to result in fewer ED visits and lower health care costs in studies both within the United States and in other countries.[5-12]

However, just as patching together the shattered pieces of a fallen vase works to undo damage that has already been done, hot spotting as a retrospective method serves to intervene on patients whose lives have already been plagued by multiple hospitalizations, worsening chronic medical conditions, and declining quality, and whose care has already driven up health care system costs. It is time to prevent the vase from crashing – to develop a system that identifies patients at high risk for high utilization before they enter a downward spiral. Such a system could be referred to as ‘prospective hot spotting,’ and could offer a promising alternative, as patients at high risk of becoming high utilizers can be identified, and interventions can be

implemented, before acute care facility visits are accumulated and health care costs are amassed.

This review aims to summarize the existing evidence for: defining and identifying high utilizers, evaluating strategies that have been implemented to reduce high utilization, and demonstrating the value in prospective, as opposed to retrospective, hot spotting.

**What is High Utilization?**

Physicians, physician assistants, social workers, and nurses each may recognize different patterns amongst their patient populations that could be used to characterize high utilization, such as frequently visiting the ED,[13] receiving care at multiple hospitals,[14] consistently having unfilled prescriptions[15], or consuming more outpatient services.[16-17] Hence the challenges faced in defining high utilization are, "Who determines the threshold for high utilization, and on what basis?" Bischoff et al. conducted a qualitative study with focus groups of primary care providers and noted that “a negative visceral reaction of the physician is the primary indicator of problematic and troublesome patient overuse of medical services.”[18] These negative feelings began with the perception of a breach of trust on the patient’s part, defined as deliberate manipulation of the medical system, repeated attempts to get something that the physician could not provide, and failure to follow through with treatment plans.[18]

Yet such a subjective measure as “a negative visceral reaction” on the part of the physician would not be a reliably quantifiable criterion in defining high utilization. In addition, the use of more objective criteria to define high utilization would be more pragmatic to a medical institution, as they could then integrated into an algorithm to systematically identify patients within this population. In the existing literature, two criteria that continually emerge when stratifying patients into utilization groups include the frequency of acute care facility visits and the total health care costs aggregated within a given time period.

*Visit Frequency*

The number of visits accumulated by patients can be gathered through billing databases or the electronic medical record. However, for such a definitive metric, there is no consensus on what quantity of visits over what set period of time equates to high utilization. A systematic review by Althaus et al. selected 11 studies that each employed visit frequency as a criterion for defining high utilization and noted various arbitrary cut offs. Some of the included studies delineated a specific frequency of visits as high utilization (e.g. greater than 3, 4, or 5 visits within 12 months);[8] other authors defined high utilizers as those patients whose number of visits were found to account for a disproportionately high percentage of the total patient population’s visits. For example, a study by Hunt et al. looked at 79.5 million ED visits gathered through the Community Tracking Household Study, a nationally representative

survey of about 17,000 respondents, and found that 8% of the cohort accounted for 28% of the total visits.[17] Separate studies by Katon et al. and Von Korff et al. defined high utilizers as those whose visit numbers in 12 months placed them at the top 10% of their age group.[19-20]

One limitation to relying on the frequency of patient visits for establishing the definition of high utilization is that it may overlook when patients consume health care resources at multiple locations. Low visit rates at one facility may not always correlate to low utilization overall, as demonstrated in a study by Hempstead et al. that found that more than 30% of high utilizers received fragmented care.[14]

*Cost*

Cost to the health care system is another potential criterion for determining those who are high utilizers. Similar to the frequency of patient visits, cost can be consistently tracked. Hansagi et al., in a study of 47,349 ED patients, found that 4% of the patients accounted for 18% of the costs incurred.[13]

However, a total dollar amount can be misleading, as different health care facilities might summate costs differently and thereby misreport the costs attributed to high utilizers. ED or hospital billed charges, for example, may not match the amount that is reimbursed by insurance companies; in fact there frequently are regional and even inter-hospital differences in the dollar amount that is charged for the same procedure or test.[21] Given the complex,

imprecise, and often incomparable billing procedures of hospitals and insurance companies, it can be difficult to measure the true total cost. Capturing these expenditures for research purposes can be difficult as well, as exemplified in Althaus et al.'s systematic review, which found cost analyses in only 3 of its 11 studies.[8]

**Who are the High Utilizers?**

For clinicians, the clinical characteristics of high utilizers are perhaps the most easily recognized commonality amongst this minority of patients, as the effects of multiple comorbid diseases contribute in many ways to increased health care utilization. Data sets such as those from the Camden Coalition suggest that certain chronic illnesses (asthma, chronic obstructive pulmonary disease, hypertension, diabetes) as well as exacerbations of certain diseases (sickle cell disease, chronic renal insufficiency, liver failure, heart failure) are common amongst high utilizers.[13-14, 22] However a conglomeration of disease processes is not the only commonality shared amongst high utilizers; certain demographic and socioeconomic characteristics, as well as social and mental health issues, have also been found to be common amongst this population.

*Demographic and Socioeconomic Characteristics*

Likely owing to the fact that the definition of high utilization may differ from study to study, the demographic characteristics in the literature also varies widely. Additionally, most of the studies aiming to describe high utilizer characteristics have been limited to the ED setting. In a 2013 systematic review by Kumar and Klein, the mean age of high utilizers in an ED setting ranged from 38- to 45-years-old,[11] while the study by Hempstead et al. suggested that more than 50% of high utilizers were 50- to 79-years-old.[14] Cohort studies enrolling patients with all insurance types suggest that Medicare and Medicaid patients are more likely to be high utilizers.[26-28] Gender and ethnic patterns are also challenging to describe due to regional sampling variations between studies: while larger studies inclusive of nationally representative samples described Medicare and Medicaid White females as being more at risk for high utilization,[14,17, 23] smaller studies including only Medicaid patients reported Hispanic and Black males as at increased risk.[25-26]

Data on the socioeconomic characteristics of high utilizers generally show that they represent a disadvantaged group.[17,23] Chan et al. conducted a cross-sectional study demonstrating that annual incomes of high utilizers were $8,000 lower than those of control patients. Additionally, high utilizers were more likely to have less than a ninth grade education and to require language interpreter services.[23,27]

The risk of high utilization also has been found to increase when basic human needs (such as shelter, access to food, etc.) are not met. Homelessness and unstable housing are known to be significant predictors for high utilization; in studies with people in unstable housing, investigators demonstrated higher use of acute care and outpatient medical services,[22, 30-31] and after assistance with housing was provided, subsequent utilization decreased.[31] Chronic hunger is also a significant risk factor for high utilization. Ramsey et al. found that people with food insecurity not only had self-rated poor health, but also more physician visits and hospitalizations than people who had more consistent access to food.[32]

*Social and Mental Health Issues*

Substance abuse, specifically alcohol and intravenous (IV) drug related abuse, predicts high utilization.[10,16,22,33] French et al. estimated costs for groups of non-drug users, non-IV drug users, and IV drug users by looking at the number of ED visits, hospitalizations, and outpatient visits for each group. They concluded that IV drug users generated about $1,000 per user in excess resource utilization relative to non-drug users.[33] Additionally, struggling with drug addiction further complicates the treatment of other medical issues, thereby serving as an additional barrier between the patient and the health care system. As a demonstration of this, Harris and Rhodes conducted a review on literature looking at IV drug users with hepatitis C, and found that they tended to be sub optimally treated. It was determined that a host of

patient-specific and social issues were at fault, these including provider expectations of patient non-adherence or patient concerns over a breach in confidentiality leading to disclosure of their hepatitis C status.[34]

There also exists a strong reciprocal relationship between mental illness and health care utilization – psychiatric disease is both a significant contributor to increased consumption of resources as well as common amongst high utilizers. As Liptzin et al. found, having a psychiatric disorder increased the cost per capita for affected patients.[1] A study by Rosenberg et al. demonstrated a significant association between increased psychological trauma resulting from physical and sexual abuse and more hospital visits.[2]

Furthermore, depression has been noted to affect 23.5% of high utilizers in an ambulatory care setting.[19] Given this prevalence, primary care providers may diagnose and manage psychiatric disorders more so than psychiatrists in a majority of high utilizers. As Kurdyak et al. demonstrated, individuals with depression alongside multiple chronic medical diseases had significantly more visits to their family physicians in general as well as specifically for emotional issues than to their psychiatrists.[35] However, Katon et al. demonstrated that while primary care physicians had good knowledge about risk factors for depression, subsequent encounters of their patients with psychiatrists revealed that 40% had been misdiagnosed or not diagnosed at all, and about two-thirds had been sub optimally treated.[19]

Access to adequately trained health care personnel is paramount, and yet the demand for full time psychiatrists exceeds the supply of patients in

need.[36] Katzelnick et al. conducted a randomized controlled trial to test an innovative intervention aimed at improving the care of patients with depression by primary care providers. The intervention entailed providers receiving targeted education, treatment assistance via drug therapy algorithms, and access to telephone-based consultation with a psychiatrist, as well as ongoing patient education and monitoring. After a 12-month period, the investigators found that patients' depression symptoms and medication prescription fill rates had each improved.[15]

**What is the evidence supporting hot spotting?**

The literature on interventions aimed at reducing high utilization has mainly been focused on hot spotting by means of targeted case management. The objective of these case management interventions, as described in a prospective study by Okin et al., is to provide high utilizers with a committed, multidisciplinary team of nurses, social workers, case managers, and physicians, who work diligently to follow the patients closely, hold regular meetings to discuss the patient cases, and create a task list based on the patients' needs. The case manager's specific role also might encompass directing patients to such programs as housing assistance, substance abuse cessation therapy, crisis support, and community outreach.[5]

A large systematic review by Althaus et al. suggested that case management intervention is an effective method for reducing unnecessary ED visits and could improve social and clinical outcomes. However, owing to a

paucity of well-designed studies, the authors concluded that an objective measure of effect could not be determined. Out of 254 potentially relevant articles, only 11 met the inclusion criteria and only 3 were randomized controlled trials.[8] Another systematic review by Kumar and Klein also looked at case management intervention; out of 2,225 articles found on initial search, only 12 were included in the final review, consisting of a mixture of study designs (8 pre/post interventions, 2 randomized controlled trials, and 2 age-matched controls). Furthermore, heterogeneity of interventions, such as housing assistance, substance abuse services, and crisis intervention, prevented direct comparisons between studies. In spite of these limitations, the authors noted that the deployment of case management interventions seemed to correlate with improved ED outcomes.[11]

**Preventing, over Patching Up**

The plight of high utilizers is one that is filled with a progressive deterioration of health and ever declining quality of life. These are patients whose lives are continually afflicted by hospital admissions and readmissions, endlessly lengthening medication lists, and irreversible advancements of chronic disease. Not only do high utilizers often succumb to end organ damage secondary to diabetes or cardiovascular disease, they may also suffer the negative consequences of chronic illness on other aspects of their lives such as job loss, financial strain, and stress.

Defining high utilization, describing high utilizer characteristics, and testing interventions aimed at reducing utilization have been critical in helping providers and other stakeholders identify and provide helpful services to patients most in need and therefore decreasing excessive health care resource consumption. Yet, the application of hot spotting today is still retrospective and despite emerging evidence of the clinical effectiveness and cost savings of case management interventions, providers are still forced to manage high utilizers and the consequences of their numerous hospitalizations and ED visits; i.e. we are still waiting for the vase to fall before patching it up.

Prospective, as opposed to retrospective, hot spotting has offered a promising alternative in the approach to intervening on high utilization, the central goal being to identify patients at high risk of becoming high utilizers in an effort to prevent the untoward effects of being high utilizers. Researchers seeking to outline the benefits of prospective hot spotting have varied in their methodology (Table 1.1). The Charlson Comorbidity Index, for example, is a model that risk stratifies patients based on chronic disease burden.[38] While the Comorbidity Index is a tool that is validated in predicting future healthcare costs,[39] it is based solely on patients' chronic disease burden, which as aforementioned is not sufficient in capturing the complexity of health care utilization.

Supplementing psychosocial factors and previous ED and hospital visit data into studies of prospective hot spotting is a way of more completely

encapsulating the elements of high utilization. The models developed by the SILVERNET-HC group in Italy and Gao et al. are examples of prospective hot spotting techniques that incorporate such elements in order to predict future hospitalizations amongst the elderly.[40-41] The SILVERNET-HC group assembled an observational cohort study with a community-dwelling elderly cohort of over 1,200 patients and constructed a database of clinical, cognitive, and psychosocial data points using previous utilization data as well as the Minimum Data Set Home Care assessment tool, a survey used by the Centers for Medicare and Medicaid. Living alone, not having a caregiver, economic hardship, and previous hospitalizations were all found to be significant predictors of future hospitalization.[40] Gao et al. also integrated chronic disease burden, psychosocial factors, and prior ED and hospital visit data into a model and applied it to a cohort of Veteran males; the results showed their model to have a strong predictive value for future hospitalization.[41] Raven et al. similarly used an algorithm combining data on psychosocial characteristics and previous ED and hospital visits in a prospective study. Using Medicaid fee-for-service records, the authors generated a score of 0-100, with a higher score indicating a higher probability of readmission in the subsequent 12 months. Additionally, they collected rich psychosocial data by conducting quantitative interviews using previously validated scales. In the end, their algorithmic approach revealed a good positive predictive value for future hospitalization.[25] These studies highlight the importance of incorporating additional factors beyond chronic disease burden into prospective hot spotting methodology.

The limiting factor for any predictive model is its sensitivity – in the case of prospective hot spotting, if the model is not sensitive enough, it may fail to detect a significant portion of patients at high risk of becoming high utilizers. The predictive algorithm constructed by Hu et al. for the purpose of identifying high utilization was notable for its applicability to any patient population, any clinical setting (home, primary care provider office, specialist office, ED, hospital), and any set of chronic diseases. Uniquely, it was also designed to detect ‘atypical’ high utilizer types that might otherwise not be exposed by other algorithmic models, thereby strengthening its sensitivity.[42]

Table 1.1. **Predictors Used in Prospective Hotspotting**

| | Multivariate Predictors |
|---|---|
| Charlson et al. 2008 | age, comorbidity, medications |
| Gao et al. 2013 | hospital characteristics, patient demographics (age, sex, marital status, race, income, VA eligibility, primary care provider, distance to nearest VA, homelessness, military service era ), utilizations and cost (number of acute hospital amdissions, ICU admissions, ED visits, specialty care visits, primary care visits), comorbidity |
| Hu et al. 2012 | number of visit types (primary care, ED, hospital, lab, etc.), demographics (age and gender), ICD9 codes |
| Landi et al. 2004 | age, gender, living alone, economic hardship, activities of daily living, number of chronic diseases, depression, home care, previous hospital admission |
| Raven et al. 2009 | utilization (hospital admissions, ED visits, clinic visits), claims data |

## Conclusion

While high utilizers represent a minority of the general population, they account for the consumption of a disproportionate share of health care resources. As important as it is to select consistently objective criteria to accurately and systematically identify high utilizers, there needs to be more precision within the literature in defining key metrics such as visit frequency and cost analysis. Additionally, studies have demonstrated that an over-reliance on data points such as visit frequency or comorbidity count alone do

not adequately embody high utilization. Understanding the socioeconomic backgrounds as well as social and mental health barriers of high utilizers is critical in making sense of their utilization patterns.

Studies have suggested that hot spotting as a retrospective method can be effective in identifying high utilizers and case management-based interventions designed to reduce excessive utilization, in spite of a lack of strong evidence. However the retrospective nature of hot spotting offers a limited perspective on a potentially preventable problem, whereby the shattered pieces of a fallen vase must be patched together after the crash has already taken place. Once patients have become high utilizers there are many detrimental effects, to the patient his/herself and to the community at large. Therefore it is crucial to look prospectively in an attempt to identify those at high risk of becoming high utilizers, and prevent the metaphorical vase from crashing to pieces. So called ‘prospective hot spotting’ methodology has developed over time, with models that incorporate chronic disease burden, psychosocial factors, and prior ED and hospital visit data having strong predictive value for future high utilization. Going forward, efforts in this line of study should continue to strive for algorithmic models that have high sensitivity with applicability to a versatile patient population, in order to prevent the downward spiral of high utilization.

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# Chapter 2: *Looking for Drivers of High Utilization*

TITLE PAGE

# Social Support as a Driver of Emergency Department Visits

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## BACKGROUND

Healthcare resource utilization patterns are a critical national focus. One area currently under heavy investigation focuses on identifying and intervening upon the small minority of patients who account for a disproportionate share of resource consumption. These patients often labeled as “high utilizers,” “frequent users,” or “frequent flyers” may make up as little as 3.1% of patients, but account for approximately 16.5% of total emergency department (ED) visits.[1] There have been numerous efforts to identify and characterize high utilizers.[1-4] Consequently, there are also intense efforts to create multivariate models that predict future high utilization patterns. Current models in the literature include but are not limited to a number of variables such as chronic disease burden, [5,6] previous visit data,[7-9] elements of social support, [6,10,11] substance abuse history,[10] perceived functional status,[12] mental illness,[10,13] perceptions of the health system,[12] and medication use.[14]

Once these high utilizers have been identified, interventions, typically a form of case management with the goal of reducing unnecessary ED visits and hospitalizations are implemented. Systematic review data on the true effect of these interventions is limited due to heterogeneity of the intervention designs.[15, 16] Despite the important role that comorbidity plays in healthcare costs, simply focusing on medical management of chronic diseases is often not sufficient. For example, preliminary data from the Medicare Coordinated Care demonstration, which tested whether care coordination and disease

management programs improved health outcomes and lowered costs found that after two years the demonstration did not find reductions in hospitalizations or decreases in Medicare Part A or B costs when compared with data prior to the project implementation.[17] Further examination of factors that drive utilization is necessary.

The objective of this study is to identify psychosocial characteristics that are more prevalent amongst patients with high comorbidity who use the emergency department (ED) compared to those with no ED use. Patients were recruited in an ambulatory care setting and the primary outcome was the frequency of emergency department visits. The secondary outcome was to measure frequency of inpatient visits.

## METHODS

With approval by the Lincoln Medical Center and Weill Cornell Medical Center Institutional Review Boards, a cohort of patients with high comorbidity were recruited for a retrospective cohort study aimed at identifying psychosocial factors that predicted hospitalization and emergency department use.

Patient Selection and Recruitment

Patient recruitment took place at two public ambulatory care centers belonging to the New York City Health and Hospitals Corporation (HHC). HHC is entity that runs the public hospitals in New York City. Inclusion criteria required that all patients be older than 18 years of age, must be able to understand written or verbal Spanish or English, and must be able to consent for themselves or have a health proxy with them. Initial screening of potential participants was done by reviewing the Internal Medicine provider schedules and selecting all patients within MetroPlus, a Medicaid Managed Care Plan. Next, the Charlson Comorbidity Index was calculated for each patient by reviewing the problem list for each patient. The Charlson Comorbidity Index is a scoring tool that uses weighted grades on a number of chronic diseases to produce a score that had has been previously validated to predict mortality[18,19] as well as costs.[5] Diagnoses in the problem list were crosschecked by reviewing imaging studies, clinic notes, and medication lists. Patients with calculated comorbidity indices ≥4 (Appendix 1) were approached after meeting with their provider for consent. The outcome of interest was the frequency of ED visits, which were confirmed by the written ED physician notes. An encounter where the patient left without being seen by a physician was not counted as an outcome. ED visits that resulted in hospitalizations were also not counted as a primary outcome, but were counted as part of the secondary outcome. The secondary outcome was the number of inpatient hospitalizations. A hospitalization was counted as an outcome if the event

occurred within one year prior to the month of a patient's enrollment and at any point until March 31, 2015. If the event occurred within the HHC hospital system, the hospitalization was confirmed by viewing discharge summaries within the electronic medical record. Hospitalizations at other facilities were counted if a patient volunteered that information during the interview. Elective or same day procedures were not counted as outcomes unless there was a complication that subsequently led to an unscheduled hospitalization.

Data Collection and Survey Methodology

Data from the electronic health record (EHR) and patients interviews were captured. A total of nineteen previously validated surveys were administered during the patient interview with the intention of characterizing the relationship between increased frequency of ED visits and the following covariates: demographic, clinical, psychological, and social. Elements of the demographic covariate included: age, gender, ethnicity, marital status, primary language, acculturation (Short Acculturation Scale for Hispanics[20]) employment status, annual income, housing stability (created by the investigator based on feedback from case managers working with high utilizing patients), and food insecurity (Household Food Security scale[21]).

Elements of the clinical covariate included: Charlson Comorbidity score, sleep quality (Pittsburgh Sleep Quality Index[22]), and substance abuse (WHO ASSIST survey[23]). Number of pregnancies was also collected as an additional measure of parental strain.

Psychological elements included measuring affect (Positive Affect/Negative Affect Scale[24]), measuring stress perception (Perceived Stress Scale[25]), screening for depression with the two question Patient Health Questionnaire (PHQ) [26, 27] followed by the PHQ-9 when necessary, screening for anxiety with the two question Generalized Anxiety Disorder scale (GAD-2) [28] followed by the GAD-7 when necessary. The Short Form 12 Question survey (SF-12) [29] was used as a measure of general mental and physical functioning. Optimism was measured with the Revised Life Orientation Test. [30]

Elements of the social covariate included: the Medical Outcomes Study (MOS) Social Support Survey 8 question short form,[31] recent life events (Social Readjustment Rating Scale),[32] neighborhood conditions, [33] access to health care (CAHPS Adult Primary Care survey).[34]

## RESULTS

### Demographic Characteristics (Table 2.1)

A total of 56 patients completed the informed consent process. Two patients withdrew shortly after consenting and 1 patient withdrew after partial completion of the survey. Forty-three patients (80%) completed the enrollment survey and had complete data. In total, there were 39 ED visits and 18 inpatient hospitalizations during the study period. Due to the small sample size, the cohort was dichotomized by no ED visits + no inpatient visits (no ED visits) and any ED visits + no inpatient visits (any ED visits). Characteristics of patients that had ED visits and any inpatient visits (any inpatient visit) are

similar to the other two groups (Table 1) and any notable differences will be mentioned.

The any ED visit group and no ED visit group were similar (Table 1): mean age was 60 years and predominantly female. Both groups were poorly acculturated, 72% identified themselves as Hispanic and 60% reported that they were non-native English speakers. The majority of the cohort reported themselves as single. 63% of the cohort did not complete high school. The mean annual income was $15,000 and most reported living in an individual apartment unit for themselves and/or for their family for at least 12 months.

There was a difference in ED visit rate in those who had home problems (e.g. too small, needed repairs, too damp). Univariate analysis demonstrated that 58% of those who reported at least minor problems compared with 33% of without problems had at least 1 ED visit. Another difference noted was that the ED visit group had a higher proportion of food insecurity when compared with the no ED visit group. Notably, the opposite was true with the any inpatient visit group where only 31% reported food security.

## Table 2.1 Demographic Characteristics

*+ This question did not specify the reason unemployment (retirement, disability, or other reasons)*
*1. An average of 2.99 (3.99) should be used to differentiate the less acculturated respondents (average score between 2 and 3.99) and the more acculturated (average score above 3.99). A mid-point in the scale should not be construed to represent biculturalism*
*2. >2 points signifies food insecurity, >5 points signifies hunger*

| | No ED visits or inpatient visits | Any ED visits, No inpatient visits | ED visits and any inpatient visits |
|---|---|---|---|
| population total, n | 24 | 19 | 13 |
| Mean Age, years (range) | 61 (47-67) | 60 (38-73) | 61 (47-70) |
| Female, % | 75 | 58 | 46 |
| Hispanic, % | 75 | 68 | 77 |
| Black, % | 29 | 37 | 31 |
| Non Black/Non-Hispanic, % | 8 | 11 | 15 |
| Without a partner or spouse, % | 58 | 58 | 54 |
| Non- English speaking, % | 67 | 53 | 46 |
| Mean Acculturation score[1], range | 3.1 (1-5) | 2.99 (1-5) | 3.46 (1-5) |
| Not Currently Employed[+], % | 88 | 84 | 85 |
| Education | | | |
| 8th grade or less, % | 29 | 21 | 8 |
| Some high school but did not graduate, % | 33 | 42 | 38 |
| High school graduate or more, % | 38 | 37 | 54 |
| Mean Annual Income, dollars (range) | 15000 (0-80000) | 15000 (0-60000) | 13000 (0-30000) |
| Living in a single family apartment, % | 67 | 47 | 38 |
| Not moved in last 12 months, % | 83 | 89 | 92 |
| Home repairs needed, % | 33 | 58 | 61 |
| Food insecure[2], % | 46 | 63 | 31 |

Clinical Characteristics (Table 2.2)

The entire cohort had a mean Charlson Comorbidity Index of 5. The most common diseases in the cohort were pulmonary diseases, diabetes mellitus, chronic kidney disease, liver disease, non-metastatic solid tumor malignancies, hypertension, and depression. The distribution of diseases amongst the three groups were relatively even with the exception of 55% of inpatients having chronic kidney disease, compared with 18% of the any ED visit group and 27% of the no ED visit group. The majority of both groups had scored >5 on the Pittsburgh Sleep Quality Index, indicating poor sleep quality. There was an average of 4 pregnancies per female in both groups (appendix 2). Both groups had high amounts of tobacco use with the any ED visit group having scores that suggest a higher risk of adverse health effects from tobacco consumption. This effect was further augmented in the any inpatient group.

Social Characteristics (Table 2.3)

Social support was a driving force on ED visit rate. Social support scores were dichotomized according to a published normative overall mean score of 70.[35] Among the entire cohort, 33% reported low social support, however 71% of patients with low social support had at least 1 ED visit, while only 27% of patients with high social support had at least 1 ED visit ($p<0.01$) (Table 2.4). This observation was consistent across both instrumental and emotional subscale scores. Among those with low instrumental support 56%

had ED visits versus 36% of those with high instrumental support had ED visits. 59% of those with low emotional support had ED visits versus 36% of those with high emotional support had ED visits (Table 2.5). Additionally, 58% of the any ED visit group versus 38% of the no ED visit group reported a major life event within the preceding 12 weeks. Those in the any ED group experienced more major injuries to themselves than the no ED visit group (Table 2.5).

Interestingly, this observation was not consistent in patients who had any ED visits and had at least 1 hospitalization. 35% of the patients with high social support had at least 1 hospital visit versus 24% of the patients with low social support had at least 1 hospital visit. 9 (69%) of the patients who had at least 1 inpatient visit reported a high level of social support. However, the rest of their characteristics were similar to the rest of the cohort

Further data analyses revealed some unique characteristics in the low social support group (Table 2.6). Patients with low social support more commonly had a listed diagnosis of depression ($p < 0.01$), but did not statistically differ from the higher social support group in regards to needing treatment for depression (score ≥ 10). The lower social support group also had lower mean annual incomes than patients with higher social support ($10,280 vs. $17,959) higher amounts of perceived stress (18 vs.15), and higher negative affect scores (22 vs.16) suggesting higher amounts of negative affect. Moreover, 58% of patients with low social support had more recent major life events, specifically major illnesses to themselves. In comparison,

those with high social support (38%) reported more deaths of their friends and family (p=0.055).

Psychological Characteristics (Table 2.7)

The any ED visit group and no ED visit group both had similar physical and mental functional health according to the SF-12. Physical and mental composite scores for both groups fell within range of the national average. [36] Both groups had positive and negative affect scores that also fell within the range of the general population average. [37] Notably, approximately 60% of the cohort had PHQ-9 scores consistent with at least moderate depression (≥10). This observation was lost in the inpatient group, where 46% had scores ≥10. The ED visit group had higher Perceived Stress scores than the no ED visit group, though this observation was not consistent in the inpatient group.

ED High Utilizers (Appendix 2.1)

Despite the limited sample size descriptive statistics of ED high utilizers (defined as ≥3 ED visits within a year) are reported. 6(32%) patients met this criterion and accounted for 22 (56%) of the total ED visits. Characteristics of the ED high utilizers resembled that of the any ED visit group.

## Table 2.2 Clinical Characteristics

*3. Minimum Score = 0 (better); Maximum Score = 21 (worse). Interpretation: TOTAL ≤ 5 associated with good sleep quality. TOTAL > 5 associated with poor sleep quality*
*4. WHO ASSIST - risk of experiencing clinical adverse events due to tobacco use. Interpretation: 0-3 Low, 4-26, Moderate, 27+ High. Value represents the percentage of those who have ever used tobacco being at moderate/high risk of suffering adverse effects of tobacco*
*5. WHO ASSIST- risk of experiencing clinical adverse events due to alcohol use. Interpretation: 0-10 Low, 11-26 Moderate, 27+ High. Value represents the percentage of those who have ever used tobacco being at moderate/high risk of suffering adverse effects of alcohol*

| | No ED visits or inpatient visits (n=24) | Any ED visits, No inpatient visits (n=19) | ED visits and any inpatient visits (n=13) |
|---|---|---|---|
| Chronic Respiratory Illness, (n=16), % | 25 | 31 | 44 |
| Diabetes Mellitus, (n=35), % | 43 | 26 | 31 |
| Diabetic Nephropathy, (n=3), % | 33 | 33 | 33 |
| Diabetic Retinopathy, (n=6), % | 50 | 17 | 33 |
| Diabetic Neuropathy, (n=9) | 56 | 33 | 11 |
| Any Liver Disease, (n=10), % | 30 | 40 | 30 |
| Cirrhosis, (n=1), % | 100 | 0 | 0 |
| Hepatitis, (n=9), % | 22 | 44 | 33 |
| Non -metastatic, solid tumor Cancer, (n=11), % | 54 | 36 | 9 |
| Chronic Kidney Disease, (n=11), % | 27 | 18 | 55 |
| Hypertension, (n=41), % | 44 | 24 | 32 |
| Depression, (n=11), % | 45 | 45 | 9 |

## Clinical Characteristics Continued

| | No ED visits or inpatient visits (n=24) | Any ED visits, No inpatient visits (n=19) | ED visits and any inpatient visits (n=13) |
|---|---|---|---|
| Pittsburgh Sleep Quality Index[3], mean, (range) | 7 (1-15) | 8 (1-16) | 6 (3-9) |
| Score >5, % | 58 | 63 | 46 |
| Tobacco use[4], % | 46 | 42 | 62 |
| Moderate/high risk of harmful effects, % | 27 | 50 | 63 |
| Alcohol use[5], % | 38 | 58 | 31 |
| Moderate/high risk of harmful effects, % | 11 | 18 | 25 |

## Table 2.3 Social Characteristics

***p<0.01*
*6. Social Readjustment Rating Scale*
*7. MOS social support survey, short form, population mean of 75, emotional support sub domain refers to expression of positive affect, empathetic understanding and the encouragement of expressions/feelings, instrumental/tangible sub domain refers to provision of material aid or behavioral assistance.*
*8. Negative neighborhood scale: range 0-20. Higher scores indicate more prevalence of negative community elements (drug dealing, shootings, bad schools, etc.)*
*9. CAHPS Adult 12 month survey ver. 2.0. Result reported as an average of responses from a 4 point Likert scale (1=Never, 2=Sometimes, 3=Usually, 4=Always)*

| | No ED visits or inpatient visits (n=24) | Any ED visits, No inpatient visits (n=19) | ED visits and any inpatient visits (n=13) |
|---|---|---|---|
| Number in household, mean | 2 | 2 | 2 |
| Caring for a child <18 yo, % | 21 | 16 | 15 |
| Major life event in last 12 weeks?** [6], % | 38 | 58 | 38 |
| MOS social support composite[7], mean (range) | 74(0-100) | 62(6-100) | 74 (25-100) |
| MOS social support instrumental[7], mean (range) | 73(0-100) | 64(0-100)) | 74 (19-100) |
| MOS social support emotional[7], mean (range) | 76(0-100) | 61(6-100) | 74 (6-100) |
| Low social support[7], % | 21 | 63 | 31 |
| Negative Neighborhood[8], mean | 3 (0-12) | 3 (0-12) | 4 (0-10) |
| Getting timely appointments, care, information[9] | Usually | Usually | Usually |
| Doctor-patient communication[9] | Always | Always | Always |

**Table 2.4. ED visits indexed on social support**

| | Any ED visits |
|---|---|
| Low social support composite (n=17), % | 71 |
| High social support composite (n=26), % | 27 |
| | |
| Low instrumental social support (n=18), % | 56 |
| High instrumental social support (n=25), % | 36 |
| | |
| Low emotional social support (n=17), % | 59 |
| High emotional social support (n=26), % | 36 |

**Table 2.5 Life Events in the last 12 weeks[6]**

| | No ED visits or inpatient visits (n=24) | Any ED visits, no inpatient visits (n=19) |
|---|---|---|
| Death of a close family member, n | 4 | 1 |
| Death of a spouse/significant other, n | 1 | 1 |
| Death of a close friend, n | 3 | 1 |
| Major illness/injury to close family member, n | 3 | 0 |
| Major illness/injury to self, n | 1 | 5 |
| Assuming responsibility for sick/elderly loved one, n | 1 | 0 |
| Experience verbal/physical abuse, n | 1 | 0 |
| You/close family member arrested, n | 1 | 0 |
| Lose your home, n | 1 | 0 |
| Major financial problems, n | 2 | 3 |
| Total events, n | 20 | 11 |

## Table 2.6 Notable Low Social Support Characteristics

***p<0.01*
*10. Value represents the percentage of those who have ever used tobacco being at moderate/high risk of suffering adverse effects of tobacco.*

| | Low social support (n=17) | High social support (n=26) |
|---|---|---|
| Chronic Respiratory Illness, (n=16), % | 38 | 62 |
| Diabetes Mellitus, (n=35), % | 46 | 54 |
| Diabetic Nephropathy, (n=3), % | 67 | 33 |
| Diabetic Retinopathy, (n=6), % | 33 | 67 |
| Diabetic Neuropathy, (n=9) | 56 | 67 |
| Chronic Kidney Disease, (n=11), % | 45 | 55 |
| Hypertension, (n=41), % | 39 | 61 |
| Depression, (n=11), %** | 73 | 27 |
| Annual Income, mean, dollars | 10,280 | 17,959 |
| Perceived stress score, mean | 18 | 15 |
| Negative affect score, mean | 22 | 16 |
| Single, % | 71 | 50 |
| Major life event, % | 65 | 34 |
| Ever used tobacco, % | 54 | 46 |
| Moderate/high risk of harmful effects,[10] % | 57 | 25 |

## Table 2.7 Psychological Characteristics

*11. SF-12 the national norm for PCS and MCS is 50 with a sd of 10*
*12. PANAS- positive affect mean score students (29.7 sd 7.9) va substance abusers (32 sd 8.5) higher score means higher positive affect, negative affect mean score students (14.8, sd 5.4) va substance abusers (23.7 sd 10.1) higher score means higher negative affect higher scores indicate higher levels of perceived stress. norm male (12.1, sd 5.9) female (13.7, sd 6.6)*
*13. PHQ9 ≥10, used as cut off to indicate depressive symptoms that warrant active treatment*
*14. GAD7≥10 used as cut off to indicate moderate anxiety symptoms*
*15. Perceived Stress score- range 0-40, higher scores indicate higher levels of perceived stress. Normative value for the entire population 13.02 sd 6.35 male (12.1, sd 5.9) female (13.7, sd 6.6), 20 is considered high*
*16. Life Orientation Test- Revised: Possible scores range from 6-30. Higher scores indicate higher levels of optimism*

| | No ED visits or inpatient visits (n=24) | Any ED visits, No inpatient visits (n=19) | ED visits and any inpatient visits (n=13) |
|---|---|---|---|
| Physical composite[11], mean (range) | 40 (26-59) | 40 (24-51) | 41 (25-54) |
| Mental composite[11], mean (range) | 48 (24-61) | 45 (20-57) | 50 (31-61) |
| Positive affect[12], mean (range) | 26 (12-48) | 28 (12-46) | 26 (12-42) |
| Negative affect[12], mean (range) | 17 (10-37) | 19 (10-39) | 15 (10-32) |
| Moderate depression[13], % | 67 | 58 | 46 |
| PHQ-9 score, range | 6 (0-21) | 5 (0-19) | 4 (0-19) |
| Moderate anxiety[14], % | 17 | 21 | 8 |
| GAD-7 score, mean | 4 (0-20) | 5 (0-19) | 3 (0-19) |
| Perceived Stress score[15], mean (range) | 15 (4-26) | 18 (2-30) | 15 (2-29) |
| Optimism[16], mean (range) | 15 (8-23) | 15 (6-20) | 15 (12-20) |

## DISCUSSION

This retrospective cohort study assessed the self-reported psychosocial characteristics of inner city managed Medicaid patients with high levels of comorbidity according to ED use. The patients in this study were mostly female, single, Hispanic, poorly acculturated, not working/unemployed. These patients mostly suffered from pulmonary disease such as COPD, asthma and bronchitis. They also tended to suffer from hypertension, diabetes mellitus, and chronic liver disease due to hepatitis, depression, and non-metastatic solid malignancies. Overall this cohort was satisfied with their access to their primary care provider. Getting appointments and communicating with their physician were not notable problems.

Our findings suggest that among people with high levels of comorbidity and low social support may visit the emergency department more often. These patients also were more likely to have a diagnosis of depression, have less income, be single, and have a major life event. These additional characteristics are informative in directing future studies in examining a possible synergistic effect between social support and those select characteristics in terms of increased ED utilization and hospitalization. With a larger sample size, any of these characteristics individually may also independently predict more utilization.

It is important to consider that measuring social support is a complex and multifactorial process. Social support can have material, emotional, affectionate, informational, and socially interactive forms.[35] The version of the

MOS Support Scale used in our study [31] calculated a composite score as well as instrumental and emotional subscales. The instrumental support subscale of the MOS Support scale is designed to assess the provision of material aid or behavioral assistance. Our results indicated that patients with any ED visits had low instrumental support. The emotional support subscale is designed to assess expression of positive affect, empathetic understanding, and encouragement of expression of feelings. [35] Our findings indicated that those with low emotional support had more ED visits.

Our findings are consistent with a number of studies in the current literature. The role of social support in health outcomes and resource utilization suggests that high utilizers generally suffer from low social support. [38] Some studies further identify specific elements such as a health proxy [39] or living alone [39, 40] as significant risk factors for more ED visits. Such results would be analogous to low levels of instrumental and emotional support as measured in our study. However, it would be prudent to developed a more nuanced assessment of social support and avoid overgeneralizing the elements of social support. A study by Blank et al. found that a majority of their high utilizers in fact were socially connected with family, friends, and religious groups. [2] Hasan et al. also demonstrated in their cohort that those who were married and having a primary care physician were positively associated with hospital readmission. [41]

Studying social support as a driver of utilization is also important because it has consequences on health outcomes. For example, Wu et al.

found that heart failure patients with lower perceived social support also tend to have more hospitalizations. [42] Ramaswamy et al. studied HIV patients and found a significant positive association with more social support and higher primary care utilization. [43] In another study involving patients who just had an acute myocardial infarction, individuals with lower social support demonstrated worse functional status, worse depressive symptoms, and worse quality of life than those with higher social support. [44]

Ultimately an accurate predictive model should not weigh a single variable too heavily. Our finding is important for the framing of future observational cohort trials since it focuses on finding individuals with high comorbidity and low social support, rather than characterizing patients that have already experienced the event of interest (ED visits and hospitalizations). For example, a future cohort trial may attempt to recruit individuals with high comorbidity that screen positive for low social support and then prospectively follow patients and see if the low social support cohort has more ED visits and hospitalizations. Should social support turn out to be a statistically significant driver of utilization, it could serve as a potential point of intervention.

There were a number of limitations to this study. First, the small sample size makes it difficult to perform more robust statistical analyses. Differences between the no ED visit group and the any ED visit group could not be analyzed for statistical significance nor could any substantial multivariate modeling be performed. The small sample size prevented the use of hospitalizations as the primary outcome. This is significant since the main

driver of healthcare cost is inpatient hospital care [45] and future studies should consider anchoring their primary outcome around hospitalizations.

Furthermore, the small sample size also prevented more nuanced descriptions of our outcomes. It would have been more informative to further separate high utilizer and non-high utilizer groups within the ED group and inpatient group. The small sample size may also explain the unexpected result of high social support amongst the inpatient group. Second, it is possible that selection bias is confounding our findings. The recruitment of this study occurred at two different primary care clinics within the South Bronx. Our results reported that the majority of the population had stable housing for at least 12 months. Unfortunately, this may suggest that certain populations who do not visit the ambulatory clinic were not captured. Populations such as the homeless have previously been shown to have higher frequencies of ED use (refs). Also, the electronic record's capability to count and display ED visits and hospitalizations is limited to a single hospital. Therefore, counts of visits may be misrepresented if patients visited multiple institutions. Third, since this study oversampled females and the Hispanic population at only two ambulatory clinics, the role of social support on ED visit frequency may not extrapolate to other populations. Fourth, the retrospective design and short follow up period following enrollment may not have been adequate to gather a sufficient number of ED visits and hospitalizations.

In conclusion, this small cohort of comorbid patients has provided some key information for future work into the predictive modeling of health care

resource utilization. This work can begin to shift the focus of utilization research by shifting the directionality of the research question. Instead of continuing to highlight patients who have already consumed resources, efforts to create models should focus on prospectively identifying patients at risk of increased utilization by screening for psychosocial risk factors.

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# APPENDIX

## APPENDIX 2.1 Emergency Department High Utilizer Characteristics

| | ED Utilizers |
|---|---|
| total, n | 6 |
| mean age, years | 61 |
| female, % | 50 |
| Hispanic, % | 83 |
| Single, % | 50 |
| non-English speaking | 67 |
| Mean acculturation score | 3.13 |
| Not Currently Employed, % | 83 |
| Did not graduate from high school, % | 67 |
| Mean Annual income, dollars | 19,528 |
| Living in a house they owned, % | 50 |

APPENDIX 2.2 Clinical Characteristics Continued

| | No ED visits or inpatient visits | Any ED visits, No inpatient visits | ED visits and any inpatient visits |
|---|---|---|---|
| Total number of females, n | 18 | 11 | 7 |
| Total number of pregnancies, n | 65 | 39 | 29 |
| ≥2 pregnancies, % | 89 | 82 | 86 |
| Comorbidity (whole cohort) | | | |
| Myocardial Infarction, (n=3), % | 33 | 0 | 67 |
| Congestive Heart Failure, (n=5), % | 20 | 20 | 60 |
| Peripheral Vascular Disease, (n=7), % | 57 | 0 | 43 |
| Cerebrovascular Accident, (n=4), % | 25 | 0 | 75 |
| hemi/paraplegia, (n=1), % | 0 | 0 | 100 |
| Connective Tissue Disease, (n=5), % | 40 | 40 | 20 |
| Peptic Ulcer Disease, (n=0) | 0 | 0 | 0 |
| Lymphoma, (n=0), % | 0 | 0 | 0 |
| Leukemia, (n=0), % | 0 | 0 | 0 |
| Metastatic Disease, (n=0), % | 0 | 0 | 0 |
| Cellulitis, (n=5), % | 40 | 20 | 40 |
| Warfarin, (n=3), % | 67 | 0 | 33 |
| HIV/AIDS, (n=1), % | 0 | 0 | 100 |